

to the proper persons to be charged with the investigation.

"We are of opinion that the Council should not have the power of initiating investigations; it should, however, not be precluded, in exceptional cases, from offering to the Minister such suggestions as it may have occasion to make in the public interest.

"We believe that reference to such a council would be found to be so useful and convenient that it would become the usual course in cases of difficulty, but we would not diminish the responsibility or fetter the discretion of any Minister by making such reference obligatory, or by preventing a reference to committees or to individuals chosen by him, whenever that course might appear to him to be more desirable.

Finally the Report concludes with the following "Conclusions and Recommendations" :—

"I. The assistance given by the State for the promotion of scientific research is inadequate, and it does not appear that the concession or refusal of assistance takes place upon sufficiently well-defined principles.

"II. More complete means are urgently required for scientific investigations in connection with certain Government departments; and physical as well as other Laboratories and apparatus for such investigations ought to be provided.

"III. Important classes of phenomena relating to Physical Meteorology, and to Terrestrial and Astronomical Physics, require observations of such a character that they cannot be advantageously carried on otherwise than under the direction of the Government.

"Institutions for the study of such phenomena should be maintained by the Government; and, in particular, an observatory should be founded specially devoted to Astronomical Physics, and an organisation should be established for the more complete observation of tidal phenomena and for the reduction of the observations.

"IV. We have stated in a previous Report that the national collections of Natural History are accessible to private investigators, and that it is desirable that they should be made still more useful for purposes of research than they are at present. We would now express the opinion that corresponding aid ought to be afforded to persons engaged in important physical and chemical investigations; and that whenever practicable such persons should be allowed access, under proper limitations, to such laboratories as may be established or aided by the State.

"V. It has been the practice to restrict grants of money made to private investigators for purposes of research to the expenditure actually incurred by them. We think that such grants might be considerably increased. We are also of opinion that the restriction to which we have referred, however desirable as a general rule, should not be maintained in all cases, but that, under certain circumstances and with proper safeguards, investigators should be remunerated for their time and labour.

"VI. The grant of 1,000*l.*, administered by the Royal Society, has contributed greatly to the promotion of research, and the amount of this grant may with advantage be considerably increased.

"In the case of researches which involve, and are of sufficient importance to deserve, exceptional expenditure, direct grants in addition to the annual grant made to the Royal Society, should be made in aid of the investigations.

"VII. The proper allocation of funds for research; the establishment and extension of laboratories and observatories; and, generally, the advancement of science and the promotion of scientific instruction as an essential part of public education, would be most effectually dealt with by a ministry of science and education. And we consider the creation of such a ministry to be of primary importance.

"VIII. The various departments of the Government have from time to time referred scientific questions to the Council of the Royal Society for its advice; and we believe that the work of a minister of science, even if aided by a well-organised scientific staff, and also the work of the other departments, would be materially assisted if they were able to obtain, in all cases of exceptional importance or difficulty, the advice of a council representing the scientific knowledge of the nation.

"This council should represent the chief scientific bodies in the United Kingdom. With this view its composition need not differ very greatly from that of the present Government Grant Committee of the Royal Society. It might consist of men of science selected by the Council of the Royal Society, together with representatives of other important scientific societies, and a certain number of persons nominated by the Government. We think that the functions at present exercised by the Government Grant Committee might be advantageously transferred to the proposed Council."

HINRICHS' "PRINCIPLES OF CHEMISTRY"

The Principles of Chemistry and Molecular Mechanics.

By Dr. Gustavus Hinrichs, Professor of Physical Science in the State University of Iowa. (Davenport, Iowa, U.S. : Day, Egbert, and Fidler, 1874.)

THIS work constitutes the second volume of a treatise on "The Principles of the Physical Sciences," and its main object is to present theoretical chemistry in its most modern aspect and to discuss its laws from a dynamical point of view. It is divided into two portions: "Molecular Statics," and "Molecular Dynamics." The former commences with an account of chemical atoms, it being premised that the conception of a chemical atom is the basis of the modern chemical theory. Although the author tells us that the chemical atom is a reality, while the philosophic atom is only a possibility, we have a little difficulty in accepting his definition of a chemical atom as "a very minute, relatively indivisible particle of matter." For it is surely unwise to retain a term so precise in its etymological significance if we admit its divisibility. We are told that "an atom of lead sulphide" can be divided into an atom of lead and an atom of sulphur; and further (p. 19), that "the molecule of gaseous compounds consists of one atom of the compound." But a molecule is defined as a "group of atoms" elsewhere, so that it would appear that a molecule is sometimes an atom, and an atom is sometimes a molecule, and such confusion of ideas must be most detrimental to the acquirement of exact knowledge by the student.

It is useless for us to protest against variations in the mode of writing formulæ, for such protestations have been made any time during the last ten years in vain; but we are quite justified in saying that such changes harass the student to an extent to which the authors of them can scarcely be aware. Why should NaCl be written NaCl^{de}, and K₂NO₃, K₂N^{ate}, and so with all sulphates, oxalates, nitrates, and a host of other salts? And why, when the almost universal custom is to write sulphates as MSO₄, and nitrates as MNO₃, does our author write MO₄S and MO₃N?

We are glad to notice the introduction of the recent surmises as to the absolute weight of atoms, although at present we believe that such ideas cannot be of much

real use to the student. We are told that a milligram of hydrogen contains about 400,000,000,000,000 atoms of hydrogen, and a milligram of gold 2,000,000,000,000 atoms, while the atomic weight of gold is given as 196; if this is admitted, the milligram of gold will contain some 40816,000,000,000 atoms in excess of the number given above, and the omission of this will in itself show the extreme generality of such statements. A curious deduction as to the *form* of atoms is drawn from the fact that many minerals are observed, when reduced to powder, to preserve their normal crystalline form; hence, says our author, "we conclude the compound atom possesses form closely related to the cleavage form."

The law of Dulong and Petit is very concisely stated, and its importance in modern chemistry is well illustrated. It is crudely formulated thus:—if a represents the atomic weight and s the specific heat, the product as will be the specific heat S of a gram-atom of the substance, and $S = as$ nearly equal to 6.3.

Or again, if the specific heat S of an element be known, an approximate determination of the atomic weight can be found as follows:—

$$a = \text{nearly } \frac{6.3}{s}$$

Thus the specific heat of lead = 0.031, consequently $\frac{6.3}{0.031} = 200$, the exact atomic weight of lead being 207.

The service afforded by the application of this law to the determination of the *right* atomic weight of an element is also shown in this case of lead, for from the analysis of oxide of lead the atomic weight of lead might be 207, or 103.5, or 69, or 414, or 621, for although we find that sixteen parts by weight of oxygen are united with 207 of lead, we have no direct chemical proof that the 207 represents one atom; but the law of Dulong and Petit now steps in and shows us that the right atomic weight is 207, because it alone satisfies the conditions of that law. And so for other elements the vapour density of whose compounds cannot be determined. The section on Atomicity or valence would be much improved by the introduction of a complete list of the elements with their atomicities, and a discussion of doubtful atomicities.

In the seventh section the author passes at once from what were once called inorganic compounds to the discussion of organic substitutions as shown in the great methyl series of compounds. Such comprehensive statements as, "the binary marsh gas, also called *methane*, CH_4 , is the basis of all organic compounds," are of great use to the student, and in this instance the statement at once justifies the passage from mineral chemistry to so-called organic chemistry without one word of introduction or comment. We do not think that the attempted graphical representation of chemical constitution in the eighth section can be productive of anything but confusion to the student. The crosses and dots and three-limbed signs have themselves to be remembered, and cannot give any precise idea of the constitution of a complex compound. A somewhat detailed account of the constitution and syntheses of various serial compounds concludes that portion of the work devoted to Molecular Statics.

The second part commences with an account of the motions of molecules, and it is asserted that since molecules are not spherical, their impact against each other

will not alone produce motion of translation, but also motion of rotation, and this is partially illustrated by the motion of a boomerang. The following definitions are stated on the authority of the author:—

1. "The molecules of a body in the gaseous condition have a motion of translation, and also a motion of rotation around their natural axis of maximum moment of inertia."

2. "The molecules of a body when in the solid state have only a vibratory motion about a position of equilibrium."

3. "The molecules of a body when in the liquid state have a vibratory motion, as in the solid state, and also a motion of rotation around their natural axis of minimum moment of inertia."

Among the concluding sections of the book is a very interesting and suggestive account of *calorization*, that is the amount of heat produced or absorbed in any chemical process. The treatment (p. 153), from a calorization point of view, of the reactions of hydrogen, chlorine, iodine, and silver, is worthy of careful study. A few pages at the end of the book treat of Systematic Chemistry and Applied Chemistry.

Dr. Hinrich's book must be used in connection with his former works, "Elements of Chemistry" and "Elements of Physics," to which frequent references are made. It is mainly intended as a guide to the student, and must be used with the assistance of a teacher. To the advanced student it will be found to be of great use, and most eminently suggestive; but it will be almost useless to any reader who has not before acquired the main principles of chemical science, together with a large storehouse of chemical facts. The work is somewhat disfigured by numerous misprints—*dissociation* (p. 21), *amides* (p. 73), *redaction* (p. 109), *energy* (p. 113), &c., and we think the two plates at the end are extremely confusing; but these minor matters are easily remedied in a second edition, and need not detract greatly from the value of a really useful and comprehensive work.

G. F. RODWELL

THE ZOOLOGY OF THE "EREBUS" AND "TERROR."

The Zoology of the Voyage of H.M.S. "Erebus" and "Terror," under the command of Captain Sir James Clark Ross, R.N., F.R.S., during the years 1839 to 1843. By authority of the Lords Commissioners of the Admiralty. Edited by John Richardson, M.D., F.R.S., &c., and John Edward Gray, Esq., Ph.D., F.R.S., &c.

No. XIX.—*Insects* (conclusion). By Arthur Gardiner Butler, F.L.S., F.Z.S., &c. 1874.

No. XX.—*Crustacea*. By Edward J. Miers. 1874.

No. XXI.—*Mollusca*. By Edgar A. Smith, F.Z.S., &c.

No. XXII.—*Birds* (conclusion). By R. Bowdler Sharpe, F.L.S., F.Z.S., &c. 1875.

No. XXIII.—*Mammalia* (conclusion). By John Edward Gray, Ph.D., F.R.S., F.L.S., &c. 1875.

No. XXIV.—*Reptiles* (conclusion). By Albert Günther, M.A., M.D., Ph.D., F.R.S., V.P.Z.S. 1875.

THE non-completion of the "Zoology of the Voyage of the *Erebus* and *Terror*" has long been a public scandal. The celebrated voyage of these ships,